REMARKS

In the Office Action, the Examiner noted that claims 1-4 and 6-12 are pending in the application and that claims 1-4 and 6-12 stand rejected. By this response claims 1, 6 and 8 are amended to more clearly define the Applicant's invention and not in response to prior art. All other claims are un-amended by this response.

In view of the above amendments and the following discussion, the Applicant respectfully submits that none of these claims now pending in the application are anticipated under the provisions of 35 U.S.C. § 102. Thus, the Applicant believes that all of these claims are in allowable form.

Rejections

A. 35 U.S.C. § 102(b)

The Examiner rejected claims 1-4, and 6-12 under 35 U.S.C. § 102(b) as being anticipated by Park (U.S. Patent 5,524,092, issued June 4, 1996). The rejection is respectfully traversed.

Claims 1-4 and 6-12

The Examiner alleges that regarding claim 1, "Park discloses a metal capped mirror, Fig. 2, comprising a stack of dielectric layers 12 and 13 of alternating high and low indices of refraction capped with a layer of metal 11, the improvement comprising a layer 12 consisting of tin oxide to which the metal capping layer 11 is directly adhered." The Applicant respectfully disagrees.

"Anticipation requires the presence in a single prior art reference disclosure of each and every element of the claimed invention, arranged as in the claim." Lindemann Maschinenfabrik GmbH v. American Hoist & Derrick Co., 221 USPQ 481, 485 (Fed. Cir. 1984) (emphasis added). The Applicant respectfully submits that Park fails to teach, suggest or disclose each and every element of the claimed invention as arranged in the Applicant's claims. Specifically, the Applicant's claim 1 recites:

"In a metal capped mirror comprising a stack of dielectric layers of alternating high and low indices of refraction capped with a layer of metal, the improvement comprising a layer consisting of tin oxide to which the metal capping layer is directly adhered <u>for improving adhesion of the metal capping layer to the stack of dielectric layers</u>."

In support of at least claim 1, the Applicant, in the specification, specifically discloses:

"A mirror comprising a stack of pairs of contiguous dielectric layers of high and low refractive indices terminates in a layer of tin oxide capped by a layer of metal, preferably gold.

In one embodiment, each pair of layers in the stack comprises a first layer of a priorly used dielectric layer, e.g., cryolite, of low refractive index contiguous with a layer of tin oxide of high refractive index. The capping layer of metal is contiguous with the layer of tin oxide of the last pair of dielectric layers in the stack.

In a second embodiment, all layers in the mirror stack, other than the last pair of layers, comprise pairs of priorly used dielectric materials, e.g., a layer of cryolite of low refractive index contiguous with a layer of zinc sulfide of high refractive index. The last stack pair, in this example, comprises a layer of cryolite contiguous with a layer of tin oxide capped, in turn, by a layer of metal." (See Specification Summary, page 2, lines 8-23).

And

"An example of a known optical device 10 using known mirrors is shown in Fig. 1. The device is a vertical-cavity, surface emitting laser (VCSEL) comprising a substrate 12 of a semiconductor material, e.g., GaAs, having a plurality of successively deposited layers on a surface 14 thereof. The first (in this example) eight layers shown comprise four pairs of layers 18 and 20 of the materials GaAs and AlAs. The two layers 18 and 20 of each pair have different refractive indices, and the four pairs of layers 18 and 20 comprise a double ended "lower" mirror 24 for providing light reflection in the upper direction (shown by arrow 26) and light transmission in the lower direction 28 (through and outwardly from the substrate 12).

The lower mirror upper surface 30 is covered with a semiconductor light emitter comprising three layers, 32, 34 and 36 of GaAs, where the bottom layer 32 is of N type conductivity, the top layer 36 is of P type conductivity, and the middle ("gain") layer 34 is undoped. By biasing the P layer 36 positive relative to the N layer 32, current is caused to flow through the middle layer 34 (from an electrode 40 contacting the P layer 36 to an electrode 42 contacting the N layer 32) which causes, as known, the emission of light within the layer 34 and transmission of light vertically outwardly from both layers 32 and 36.

> Mounted on the upper surface 44 of the P layer 36 is a stack 50 of (in this example) eighteen layers comprising nine pairs of layers 18 and 20 of the materials cryolite and zinc sulfide (not the same as in stack 24). The nine pair stack 50 also constitutes a mirror, but of the single ended type, that is, the upper end 54 of the stack is capped with a layer 52 of metal for maximum reflectivity and no light transmission in the upward direction 58. As previously noted, different metals, such as gold, silver, copper and aluminum, are used as capping layers but, in general, gold is the preferred material owing to superior optical performance and high chemical inertness. A problem with the use of such metals (generally less so with aluminum) is that they tend to be poorly adherent to known dielectric materials used in mirror stacks of the type shown in Fig. 1." (See Specification, page 3, line 17 through page 4, line 26).

And

> "In accordance with one embodiment of the invention, an improvement in adhesion of the metal layer 52 in the stack shown in Fig. 1 is obtained by direct replacement of the sapphire layer 60 shown in Fig. 1 with a layer of tin oxide." (See Specification, page 5, lines 9-12).

It is evident from at least the portions of the Applicant's specification recited above that the Applicant's invention is directed, at least in part, to an improvement of a metal capped mirror having a stack of dielectric layers of alternating high and low indices of refraction capped with a layer of metal, "the improvement comprising a layer consisting of tin oxide to which the metal capping layer is directly adhered", the layer of pure tin oxide being implemented to improve the adhesion of the metal layer to the dielectric layers. The Park reference fails to teach, suggest or disclose an improvement to a metal capped mirror as taught in the Applicant's specification and claimed in at least the Applicant's claim 1.

More specifically, the Examiner alleges that FIG. 2 of Park teaches a mirror as claimed and taught by the Applicant. In contrast to the Applicant's invention, however, Park does not teach, suggest or disclose a metal capped mirror **having a stack of dielectric layers of alternating high and low indices of refraction** capped with a layer of metal. Park instead teaches a multilayered ferroelectric-semiconductor memory-device. The layers of the invention of Park do not comprise stacks of dielectric layers of alternating high and low indices of refraction. Instead, Park teaches a ferroelectric-semiconductor interface memory diode consisting of "a layer of metal

electrode, a layer of diffusion barrier conductor, a layer of ferroelectric material, a layer of semiconductor crystal, and a layer of metal electrode." (See Park, Abstract). Park further teaches a ferroelectric-semiconductor interface memory element consisting of "a layer of metal electrode, a layer of diffusion barrier conductor, a layer of ferroelectric material, another layer of diffusion barrier conductor, a layer of semiconductor crystal, and a layer of metal electrode." (See Park, Abstract). In Park, the two values of maximum capacitance in a single capacitor are achieved in the capacitive diodes by making use of accumulation, depletion, or inversion of semiconductor surface charges as a result of the orientation of the remnant polarization of ferroelectric in proximity. However, there is absolutely no teaching, suggestion or disclosure in Park for a mirror having a stack of dielectric layers of alternating high and low indices of refraction as recited in at least the Applicant's claim 1 or for an improvement to a mirror as taught and claimed by at least the Applicant's claim 1. Park actually teaches away from the invention of the Applicant. The Applicant's invention is directed at least in part to an improved mirror for achieving substantially 100% reflection using at least the metal capped layer. As such it is extremely important for the metal capped layer to remain affixed to the dielectric layers. Thus, the improvement of the Applicant's invention, specifically the layer of tin oxide for improving the adhesion of the metal capped layer to the dielectric layers is extremely important. The invention of Park does not teach or suggest, nor does it desire any such reflection. The invention of Park is directed to a device that stores information and any reflection will diminish the effectiveness of the invention of Park. As such, Park teaches away from the invention of the Applicant in that it teaches an apparatus that does not require or desire any reflectivity as taught and claimed by the Applicant's invention. Again, the layers of Park do not comprise dielectric layers of alternating high and low indices of refraction and as such the invention of Park does not teach the structure of the Applicant's invention at least with respect to claim 1.

Even further, Park fails to teach, suggest or disclose an improvement to the

specific type of mirror taught and claimed by the Applicant; "the improvement comprising a layer consisting of tin oxide to which the metal capping layer is directly adhered for improving adhesion of the metal capping layer to the stack of dielectric layers." In support of the improvement taught and claimed by the Applicant, the Applicant specifically recites:

> "The use of layers of tin oxide in devices other than mirror stacks is known, and known processes can be used for applying tin oxide layers for use in mirror stacks in accordance with this invention.
>
> In one test, layers of tin oxide (SnO) were deposited on a GaAs substrate at approximately 2 A^0/sec using electron beam heating of a source material of stoichiometric tin oxide (SnO2). Then, various metal capping metals, e.g., gold and copper, were deposited by resistive heating of source materials on respective tin oxide layers. For comparison, the metal capping layers were also deposited on typical dielectric layers used in mirror stacks, e.g., silicon monoxide, silicon dioxide, and titanium dioxide. A standard test for adhesion was perfomed on the various samples; namely, they were subjected to two minutes in an ultrasonic bath and the degree of delamination of the capping layers was noted. Significantly, less delamination occurred with the metal layers adhered to the tin oxide layers.
>
> While all possible layers useful as capping layers were not tested, based upon experience, the technical literature and the limited tests actually made, it is expected that, in general, and particularly with chemically **"pure" (stoichiometric) tin oxide (SnO^2) layers** prepared using standard commercially available apparatus, improved adhesion over what was heretofore available is obtained using, in accordance with the invention, a tin oxide layer for adhering a metal capping layer to the end of a mirror stack of dielectric layers. (See Specification, page 5, line 13 through page 6, line 12). (emphasis added).

The Applicant respectfully submits that there is absolutely no teaching, suggestion, or disclosure in Park for "a layer consisting of tin oxide to which the metal capping layer is directly adhered for improving adhesion of the metal capping layer to the stack of dielectric layers" as taught and claimed by the Applicant in at least claim 1. In fact there is absolutely no teaching at all in Park for a layer of tin oxide as taught and claimed in the invention of the Applicant. In contrast to the Applicant's invention, the Park reference specifically teaches:

> "A layer 2 of conducting refractory metal, such as titanium(Ti), tungsten(W), or conducting oxide such as ITO(indium tin oxide), or conducting silicon-nitride with a thickness not exceeding 1000 .ANG. in order to have a proximity effect, is established below the first layer of metal 1." (See Park, col. 4, lines 23-28).

In his rejection of the Applicant's claims, the Examiner alleges that the indium tin oxide taught in Park anticipates the tin oxide taught and claimed by the Applicant. The Applicant respectfully disagrees. As clearly indicated by at least the portion of the Applicant's specification presented above, the invention of the Applicant specifically incorporates the use of tin oxide to improve the adhesion between the metal layer and the dielectric layers of a metal capped dielectric mirror. As such, once again, the teachings of Park teach away from the invention of the Applicant. Specifically, indium tin oxide is an indium oxide doped with tin oxide. As such, indium tin oxide is indium oxide with impurities (tin oxide) therein. Park fails to teach, suggest or disclose if such a combination (indium tin oxide) will improve the adhesion of a metal capped layer to a stack of dielectric layers in a metal capped dielectric mirror. That is, in the invention of the Applicant, the Applicant determined that tin oxide will improve the adhesion of a metal capped layer to a stack of dielectric layers in a metal capped dielectric mirror. The Applicant did not determine whether indium tin oxide improves the adhesion of a metal capped layer to a stack of dielectric layers in a metal capped dielectric mirror. As such, the Applicant only claims tin oxide for improving the adhesion of a metal capped layer to a stack of dielectric mirrors in a metal capped dielectric mirror. **Even further, there is absolutely no teaching, suggestion or disclosure in Park that indium tin oxide performs the function of tin oxide (i.e., for improving the adhesion of a metal capped layer to a stack of dielectric layers) as taught by the Applicant's Specification and claimed by at least the Applicant's claim 1. As such, the indium tin oxide taught in Park can not be equated to the claimed layer of tin oxide or the function of the claimed layer of tin oxide of the Applicant's invention because Park fails to teach, suggest or disclose that the indium tin oxide taught in Park is**

capable of at least "improving adhesion of the metal capping layer to the stack of dielectric layers" in a metal capped dielectric mirror as taught in the Applicant's Specification and claimed by at least the Applicant's claim 1.

For at least the reasons stated above, the Applicant respectfully submits that the teachings of Park do not teach, suggest or disclose the invention of the Applicant at least with respect to claim 1. That is, Park fails to teach, suggest or disclose each and every element of the claimed invention as arranged in the Applicant's claims as required for anticipation. More specifically, Park fails to teach, suggest or disclose at least "a layer consisting of tin oxide to which the metal capping layer is directly adhered for improving adhesion of the metal capping layer to the stack of dielectric layers" as taught in the Applicant's Specification and claimed by at least the Applicant's claim 1.

Therefore, the Applicant submits that claim 1 is not anticipated by the teachings of Park and, as such, fully satisfies the requirements of 35 U.S.C. §102 and is patentable thereunder.

Likewise, independent claims 6 and 8 recite similar relevant features as recited in claim 1. As such, the Applicant submits that independent claims 6 and 8 are also not anticipated by the teachings of Park and also fully satisfy the requirements of 35 U.S.C. §102 and is patentable thereunder.

Furthermore, dependent claims 2-4, 7 and 9 -12 depend either directly or indirectly from independent claims 1 and 8 and recite additional features therefor. As such and for at least the reasons set forth herein, the Applicant submits that dependent claims 2-4, 7 and 9 -12 are also not anticipated by the teachings of Park. Therefore the Applicant submits that dependent claims 2-4, 7 and 9 -12 also fully satisfy the requirements of 35 U.S.C. §102 and are patentable thereunder.

The Applicant reserves the right to establish the patentability of each of the claims individually in subsequent prosecution.

B. 35 U.S.C. § 102(b)

The Examiner rejected claims 1-4, 7, 8, 11 and 12 under 35 U.S.C. § 102(b) as being anticipated by Tokito et al. (U.S. Patent 5,780,174, hereinafter "Tokito"). The rejection is respectfully traversed.

The Examiner alleges that regarding claim 1, "Tokito et al. disclose a metal capped mirror, Fig. 1, comprising a stack of dielectric layers 12 of alternating high and low indices of refraction capped with a layer of metal 22, the improvement comprising a layer 14 consisting of tin oxide to which the metal capping layer 22 is directly adhered." The Applicant respectfully disagrees.

Again, "Anticipation requires the presence in a single prior art reference disclosure of each and every element of the claimed invention, arranged as in the claim." Lindemann Maschinenfabrik GmbH v. American Hoist & Derrick Co., 221 USPQ 481, 485 (Fed. Cir. 1984) (emphasis added). The Applicant respectfully submits that Tokito fails to teach, suggest or disclose each and every element of the claimed invention as arranged in the Applicant's claims.

As evident from at least the portions of the Applicant's specification depicted above and as discussed above, the Applicant's invention is directed, at least in part, to an improvement of a metal capped mirror having a stack of dielectric layers of alternating high and low indices of refraction capped with a layer of metal, "the improvement comprising a layer consisting of tin oxide to which the metal capping layer is directly adhered for improving adhesion of the metal capping layer to the stack of dielectric layers". The Tokito reference fails to teach, suggest or disclose an improvement to a metal capped mirror as taught in the Applicant's specification and claimed by at least the Applicant's claim 1.

As previously described, the Examiner alleges that FIG. 1 of Tokito teaches a mirror as claimed and taught by the Applicant. More specifically, the Examiner alleges that the metal mirror of Tokito teaches the metal capping layer of the Applicant's invention and that the transparent conductive layer 14 of Tokito teaches the tin oxide

layer of the Applicant's invention. However, in contrast to the Applicant's invention, Tokito teaches a micro-optical resonator type organic electroluminescent device utilizing an organic electroluminescent material high in emission efficiency but broad in emission spectrum width formed by a multi-layered mirror and a metal mirror. (See Tokito, Abstract). More specifically, Tokito recites:

> "A metal mirror 22 is formed on the organic compound layer mentioned above. In addition to its function as a cathode, the metal mirror also performs a function to reflect light emitted from the luminous layer 16.
>
> The metal mirror 22 of a small work function is used to allow the electrons as carriers to be easily introduced into the organic compound layer. The metal mirror should preferably have a high light reflectance, specifically, the reflectance should be 90% or greater.
>
> Actual examples of materials used for the metal mirror 22 include Al, Mg, Ca, Li, Na, Ag, or Y, or alloys of those metals." (See Tokito, col. 6, line 62 through col. 7, line 6).

As evident from at least the portions of the disclosure of Tokito depicted above, in Tokito a metal mirror is formed and adhered to an electron transport layer and not to what the Examiner considers as a layer of tin oxide, more specifically a transparent conductive layer 14. This is in direct contrast to the invention of the Applicant which teaches and claims "a layer consisting of tin oxide to which the metal capping layer is directly adhered". As such, the Applicant submits that Tokito fails to teach, suggest or make obvious at least the Applicant's claim 1 wherein "a layer consisting of tin oxide to which the metal capping layer is directly adhered" is claimed.

Furthermore and with respect to what the Examiner considers the tin oxide layer of Tokito, Tokito specifically recites:

> "The multi-layered mirror 12 reflects light at the interfaces of the layers. The thickness of the multi-layered mirror 12 is set at .lambda./4 with respect to the wavelength .lambda. (required emission wavelength) of the light to be used so that a stronger light is produced by light beams reflected by the respective interfaces.

> Formed on the multi-layered mirror 12 is a transparent conductive layer 14 as the anode. For the transparent conductive layer 14, a material of a large work function is used so that holes as carriers can be easily introduced into the organic compound layer. The materials that can be used for the transparent conductive layer 14 are a metal such as Pt, Au, Ni, Cu, Ag, Ru, or Cr or a transparent conductive oxide such as ITO (Indium Tin Oxide), SnO.sub.2, In.sub.2 O.sub.3 or ZnO or a composite material of those materials." (See, Tokito, col. 5, line 66 through col. 6, line 13).

As previously stated, in his rejection of the Applicant's claims, the Examiner alleges that the indium tin oxide taught in Tokito anticipates the tin oxide taught and claimed by the Applicant. The Applicant respectfully disagrees. As clearly indicated by at least the portion of the Applicant's specification presented above, the invention of the Applicant specifically incorporates the use of tin oxide to improve the adhesion between a metal layer and the dielectric layers of a metal capped dielectric mirror. As such, the teachings of Tokito actually teach away from the invention of the Applicant. Specifically, indium tin oxide is an indium oxide doped with tin oxide. On the other hand, indium tin oxide is indium oxide with impurities (tin oxide) therein. Tokito fails to teach, suggest or disclose if such a combination (indium tin oxide) will improve the adhesion of a metal capped layer to a stack of dielectric layers in a metal capped dielectric mirror. That is, in the invention of the Applicant, the Applicant determined that tin oxide will improve the adhesion of a metal capped layer to a stack of dielectric layers in a metal capped dielectric mirror. The Applicant did not determine whether indium tin oxide improves the adhesion of a metal capped layer to a stack of dielectric layers in a metal capped dielectric mirror. As such, the Applicant only claims tin oxide for improving the adhesion of a metal capped layer to a stack of dielectric mirrors in a metal capped dielectric mirror. **Even further, there is absolutely no teaching, suggestion or disclosure in Tokito that indium tin oxide performs the function of tin oxide (i.e., for improving the adhesion of a metal capped layer to a stack of dielectric layers) as taught by the Applicant's Specification and claimed by at least the Applicant's claim 1. As such, the indium tin oxide taught in Tokito can not be equated to the claimed**

layer of tin oxide or the function of the claimed layer of tin oxide of the Applicant's invention because Tokito fails to teach, suggest or disclose that the indium tin oxide taught in Tokito is capable of at least "improving adhesion of the metal capping layer to the stack of dielectric layers" in a metal capped dielectric mirror as taught in the Applicant's Specification and claimed by at least the Applicant's claim 1.

For at least the reasons stated above, the Applicant respectfully submits that the teachings of Tokito do not teach, suggest or disclose the invention of the Applicant at least with respect to claim 1. That is, Tokito fails to teach, suggest or disclose each and every element of the claimed invention as arranged in the Applicant's claims as required for anticipation. More specifically, Tokito fails to teach, suggest or disclose at least "a layer consisting of tin oxide **to which the metal capping layer is directly adhered**" where the tin oxide layer is adapted "for improving adhesion of the metal capping layer to the stack of dielectric layers" as taught in the Applicant's Specification and claimed by at least the Applicant's claim 1.

Therefore, the Applicant submits that claim 1 is not anticipated by the teachings of Tokito and, as such, fully satisfies the requirements of 35 U.S.C. §102 and is patentable thereunder.

Likewise, independent claims 6 and 8 recite similar relevant features as recited in claim 1. As such, the Applicant submits that independent claims 6 and 8 are also not anticipated by the teachings of Tokito and also fully satisfy the requirements of 35 U.S.C. §102 and is patentable thereunder.

Furthermore, dependent claims 2-4, 7 and 9 -12 depend either directly or indirectly from independent claims 1 and 8 and recite additional features therefor. As such and for at least the reasons set forth herein, the Applicant submits that dependent claims 2-4, 7 and 9 -12 are also not anticipated by the teachings of Tokito. Therefore the Applicant submits that dependent claims 2-4, 7 and 9 -12 also fully satisfy the requirements of 35 U.S.C. §102 and are patentable thereunder.

The Applicant reserves the right to establish the patentability of each of the claims individually in subsequent prosecution.

Conclusion

Thus the Applicant submits that none of the claims, presently in the application are anticipated under the provisions of 35 U.S.C. § 102. Consequently, the Applicant believes that all of these claims are presently in condition for allowance. Accordingly, both reconsideration of this application and its swift passage to issue are earnestly solicited.

If however, the Examiner believes that there are any unresolved issues requiring adverse final action in any of the claims now pending n the application, it is requested that the Examiner telephone Jorge Tony Villabon, Esq. at (732) 530-9404 x1131 or Eamon J. Wall, Esq. at (732) 530-9404 so that appropriate arrangements can be made for resolving such issues as expeditiously as possible.

Respectfully submitted,

E M Wall

Eamon J. Wall Attorney
Reg. No. 39,414

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CUSTOMER #46,363
MOSER, PATTERSON & SHERIDAN, LLP
595 Shrewsbury Avenue, Suite 100
Shrewsbury, New Jersey 07702
732-530-9404 - Telephone
732-530-9808 – Facsimile